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Volume III

SURVEY PLAN FOR SPECIFIED AIR POLLUTION SOURCES

by

M.E. Fogel, R.E Folsom, E.L. Hill, F.A. Ayer

Prepared for:
Division of Economic Effects Research
Air Pollution Control Office
Environmental Protection Agency

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A survey plan intended to increase the statistical validity of future Cost of Clean Air reports is presented in this volume. Eleven industrial sources are included in the sampling plan. These are: asphalt batching, brick and tile, coal cleaning, grain milling (animal feed only) and handling, lime, petroleum refining, petroleum storage, rubber (tires), secondary nonferrous, sulfuric acid, and varnish. Survey instruments are presented in Appendix I. Sampling design recommendations are presented for national, state and metropolitan area surveys. Recommendations for mail and follow-up procedures are also discussed. Finally, estimation techniques are presented.

Published separately as a part of this research study are: (1) the main report that includes the estimates of the air pollution control costs and economic impact that will result from implementation of the Clean Air Act, as amended (Volume I); and (2) computer programs that will facilitate future cost projections (Volume II).

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Volume III

Survey Plan for Specified Air Pollution Sources

I. INTRODUCTION

The objective of this volume is to present the results of a study designed to develop sampling plans that will increase the accuracy of future air pollution control cost and emission estimates. Past and present cost and emission estimate analyses have clearly established the desirability of conducting such an undertaking. Estimating analyses made to date were based on minimal amounts of available data and information with which to develop estimating relationships of key parameters for various sources. Due to the limited objectives of this study, as well as a recognized undesirability of creating a massive data handling situation, the questionnaires have been designed for applicable data acquisition only.

II. SELECTION OF SOURCES TO BE SURVEYED

The first step in this study was to select from the twenty-three major categories of air pollution sources studied in the latest Cost of Clean Air report, sources for which sampling plans should be developed. The two major criteria for the selection were: (1) the need for such a survey, and (2) the absence of completed, ongoing, or proposed efforts by other air pollution research groups. On the basis of the above criteria and in agreement with APCO personnel, it was finally decided to limit this effort to eleven industrial process sources. These industries are sulfuric acid, petroleum refining, asphalt batching, lime, coal cleaning, petroleum products and storage, grain milling and handling, varnish, rubber, secondary nonferrous metallurgy, and brick and tile. These are air pollution sources for which even minimal additional information would significantly increase the accuracy of future cost and emission estimates. A complete set of sample questionnaires may be found in Appendix I.

III. DEVELOPMENT OF THE SURVEY INSTRUMENTS

In general, each questionnaire requests three levels of information and data. The first page of each questionnaire requests only general information for purposes of identification and other administrative requirements useful in the survey procedure. One exception is the question relating to the average number of production and production-related workers currently employed. This statistical parameter may be useful in the development of certain regression estimators which will be explained later. The second level of information deals with general plant production and capacity, the number of key unit processes on-site, and fuel use and characteristics, as applicable. The third level of information deals with specific process data. This information includes individual unit process capacities, fuel utilization, and other process variables necessary to perform air pollution engineering calculations, as well as information describing existing air pollution control systems, including dates of installation and estimated removal efficiencies. In those cases where the questionnaire could be limited to two pages, the second and third levels of desired information were combined under a single section heading called "Plant Information." The purpose of this was to achieve survey instruments of maximum simplicity. Simplicity was a guiding principle in the design of all the survey instruments.

The reader will note that responses relating to the costs of presently installed air pollution control equipment are not elicited from the survey respondents. At the outset of the development of the survey, it became apparent that the most critical data needs, at this time, are not specific cost data from the usually small percentage of plants which are already under control, but data which may be described as the key determinents of cost for the entire industry assuming full implementation. In other words, it is more critical to know the level of control for the industry than specific cost information for a small number of plants. To adequately determine cost data would have required an additional section of some length and complexity which might have the effect of reducing overall sample response levels. It was felt that sample response must be kept at the highest possible level in order to determine the value of the

key cost and emission estimating parameters even at the expense of specific cost data. In general, experience has shown that responses relating to costs lead to statistical measures with extremely wide variances and, on some occasions, make the mean values highly suspicious. This may be due in a large part to highly varying accounting practices of each firm. The initial gray iron survey [Ref. 1] may be a good case in point. In an earlier research project [Ref. 2], use of the data from the survey was tried but the results were discouraging. These facts coupled with the need to determine the statistical value of key cost estimators resulted in the decision to exclude survey questions relating directly to control costs.

IV. THE SAMPLE DESIGN

A. Sample Size

Questionnaires have been proposed for the survey of industrial sources which solicit three broad classes of information from the respondent. The first section of each questionnaire deals with general plant information including, for example, the average number of production and production-related workers currently employed. The second section deals with general plant production or capacity information, such as rated plant capacity as total daily capacity. The third section deals with specific plant processes (kilns, boilers, furnaces, etc.); information concerning their capacities as well as their associated air pollution control systems is requested.

In addition to the measures dealing with plant capacity, certain measures relating the proportions of plant processes with various pollution control systems will be important parameters in the subsequent cost analyses. Knowledge of the proportion of refinery storage tanks equipped with a floating roof is important, for example, in determining the current degree of emission control. Since such proportions or P values have a limited range and a simplified form of sampling variability, they can be exploited for the purpose of sample size determination. Tables 1 and 2 show sample size requirements designed to yield confidence intervals of lengths .02, .05, and .10 which contain the "true" proportion P with approximate probability .95 and .99. As P increases to

.5 and the width of the desired interval decreases to .02, the required sample size rapidly increases.

If we settle on a sample of 1300 plants from a source where the sampling fraction is small (e.g., petroleum storage), Tables 1 and 2 state that we could then construct a confidence interval of length .05 which would contain a P-value in the neighborhood of .10 to .15 with probability .99 and P-values in the neighborhood of .20 to .25 with probability .95.

TABLE 1. - SAMPLE SIZE REQUIRED TO YIELD A CONFIDENCE INTERVAL OF LENGTH 2d WITH PROBABILITY ∿.95 OF CONTAINING THE TRUE PROPORTION P

	2d=.02	2d=.05	2d=.10
P=.10	3460	555	139
P=.20	6150	985	243
P=.25	7200	1050	288
P=.50	9600	1535	384

TABLE 2. - SAMPLE SIZE REQUIREMENTS TO YIELD A CONFIDENCE INTERVAL OF LENGTH 2d WITH PROBABILITY ∿.99 OF CONTAINING THE TRUE PROPORTION

	2d=.02	2d=.05	2d=.10
P=.10	5970	955	238
P=.20	10600	1700	425
P=.25	12442	1990	497
P=.50	16590	2655	664

With these results in mind, a sampling protocol which called for 1300 plants from each source which contained 1,300 and a complete census of the plants in the remaining sources, would seem appropriate when national estimates were desired. Such sample sizes would preclude sampling in all but three of the sources indicated in Table 3 namely petroleum products and storage facilities, grain milling, and grain

TABLE 3. NUMBER OF INDUSTRIAL SOURCES BY TYPE IN THE NATION
1967-DATA

	Source		Number of Plants in the Nation
1.	Asphalt Batching		1,297
2.	Brick and Tile		421
3.	Coal Cleaning		691
4.	Grain Milling and Handling:	Milling*	2,496
		Handling*	11,905
5.	Lime		262
6.	Petroleum Refining		263
7.	Petroleum Storage		29,664
8.	Rubber		59
9.	Secondary Nonferrous Metallurgy		191
10.	Sulfuric Acid		212
11.	Varnish		220

* Samples to be drawn separately.

handling facilities (elevators). With the complete census in the other sources, this constitutes a sample of 7,523 plants (1,300 plants per sample x 3 samples plus the 3,623 plants remaining to be a part of the census).

B. Subpopulations and Stratification

If separate estimates for states and individual metropolitan areas were required, enrichment of the sample in these areas would be required. A sample of one hundred plants from each state where that many or more are available and a census of the remainder would not be over zealous in the light of Tables 1 and 2 if state estimates were required, and especially if state by state comparisons were of interest. As far as individual metropolitan area estimates are concerned, such a requirement would necessitate a complete census of all eleven sources.

C. Frame Limitations

Although desirable, stratification by some measure of plant capacity will be limited by the detail which is available from the lists used as sampling frames for the three sources to be sampled. Good candidates for such stratification include 1967 data by plants for total gasoline storage capacity based on the number and size of storage tanks (petroleum storage), and numbers of employees and elevator size for grain milling and handling operations. Grain elevators, for example, can be classified into ten sizes by employment categories as in Table 4.

TABLE 4. - USDA LISTING OF WAREHOUSES APPROVED TO HANDLE GRAIN UNDER COMMODITY CREDIT CORPORATION UNIFORM GRAIN STORAGE AGREEMENT, BY EMPLOYMENT CATEGORIES

Elevator Size	1	2	3	4	5	6	7	8	9	10
National Total	355	1345	2056	2162	2554	1530	774	216	89	43

A Dun and Bradstreet list has been obtained for the grain milling sources. The completeness of this frame is not known but it would appear to be the best available. The "complete" list of USDA "approved" grain warehouses by state can also be obtained. More or less complete lists for the remaining sources are also readily available with the exception of petroleum storage. Although there are serious dangers of noncoverage

errors biasing survey results when potentially incomplete lists are used as sampling frames, it should be possible to get a rough indication of the coverage level in each source by including in the questionnaire an inquiry about the total number of plants of that source to be found in the same county as the sampled plant. This information could provide an estimate of the total number of plants for each source which could be compared with the sampling frame.

V. MAIL AND FOLLOW-UP PROCEDURES

The standard mail survey calls for an initial mailing, one or two follow-up mailings (sometimes certified mail helps), and finally telephone or personal interview of a subsample of nonrespondents. Although the latter two operations are more costly, they are often necessary to bring the response rate up to an acceptable 80 percent. When nonresponse levels are as high as can be anticipated in a mail survey, failing to resort to more intensive methods of soliciting a response can lead to seriously biased results. If, for instance, response rates were much higher for plants with more extensive air pollution control systems, the industry wide level of pollution control would be grossly over-estimated.

Discussing administrative considerations pertinent to survey sample design, Tore Dalenius (1969) [Ref. 3] states that in a mail survey, it is important to keep a daily cumulative record of the responses so that action can be initiated immediately if the response rate is too low. In addition to this "signal system," Dalenius warns that an "emergency plan" must be available and resources set aside to cope with the situation should the response rate prove to be too low.

With these considerations in mind, it is recommended that a certified mail follow-up be made after 15 days with a regular mail follow-up 25 days after the initial mailing. Thirty-five days after the initial mailing, if 85 percent or more of the questionnaires for each source have not been returned in an acceptable form, telephone interviewing should begin on a subsample of nonrespondents adequate to yield a final response rate of 85 percent. Some follow-ups will also be required for incomplete or incorrectly completed questionnaires.

It may not be necessary to have the telephone respondents answer the entire questionnaire, if it is felt from engineering experience with the processes and tests formed on the mail responses that a few basic responses could be used in a regression estimator to predict the more pertinent variables. This possibility will be discussed in the next section on estimation.

The above discussion of follow-up procedures must be slightly modified if state by state estimators are required. For the final follow-up procedure, it is recommended that nonrespondents be ordered by state (state ordering should be random, however), and the subsample of nonrespondents be chosen in a systematic manner. This procedure should be slightly qualified so that at least one nonrespondent in each state be included. This system is described as proportional allocation with a minimum of one.

With simplified questionnaires it does not appear that pretesting is warranted. If obvious problems do arise, however after the first mailing, the questionnaire should be revised and the procedure initialized. It is doubtful that such problems will arise. However, if pretesting is needed, do not send the totally revised questionnaire to the respondents. All that is required is a letter requiring answers to specific misunderstood sections.

Finally, all mailed questionnaires should be accompanied by an appropriate cover letter. It is extremely advantageous that this letter have the highest level signature possible. In addition, the letter should cover the objectives of the survey, how the data will be used, statements of data confidentiality, where appropriate, as well as the legislative or executive mandates giving rise to the survey.

VI. ESTIMATION

Consider for the moment, the finest level of stratification that is achieved for a particular source. Grain elevators, for instance, could be stratified by the three sizes of community categories, by state, and further by the ten-class size and employment scale. Suppose a typical stratum (h) can be used to measure both the number of production

employees x_{ih} and some appropriate measure of plant capacity y_{ih}. For the subsample of nonrespondents to the mail questionnaires who are contacted by telephone, only ask for the number of production employees. For an estimate of $\bar{Y}_h$, the average capacity for stratum (h) plants is:

$$(\bar{y}_h)_{lr} = \bar{y}_h + \hat{\beta}\,(\bar{x}_{h1} - \bar{x}_{h2}) \tag{1}$$

and the corresponding estimate of the total capacity for stratum (h) is:

$$(\hat{Y}_h)_{lr} = N_h\,(\bar{y}_h)_{lr} \tag{2}$$

where $\bar{x}_{h1}$ and $\bar{x}_{h2}$ are the average number of employees in the mail and telephone surveys respectively for stratum (h), and $\hat{\beta}$ is the linear regression coefficient for the regression of y on x over all strata.

Cochran (1953) [Ref. 4] in his section 12.7 on Double Sampling gives the sample estimator for the variance of $(\bar{y}_h)_{lr}$ as:

$$\begin{aligned} \text{var}(\bar{y}_h)_{lr} &= s^{2h}_{y.x}/n_{1h} + (S^2_{yh} - s^{2h}_{y.x})/n_{2h} \\ \text{var}(\bar{y}_h)_{lr} &= \{s^{2h}_{y.x} + K_h(S^2_{yh} - s^{2h}_{y.x})\}/n_{1h} \end{aligned} \tag{3}$$

where

$$s^{2h}_{y.x} = \{\sum_{i=1}^{n_{1h}} (y_{ih} - \bar{y}_h)^2 - \hat{\beta}^2 \sum_{i=1}^{n_{1h}} (x_{ih1} - \bar{x}_{h1})^2\}/(n_{1h} - 2)$$

$$s^2_y = \sum_{i=1}^{n_{1h}} (y_{ih} - \bar{y}_h)^2 /(n_{1h} - 1)$$

and

$k_h = n_{1h}/n_{2h}$ = ratio of mail to telephone responses in stratum (h).

We can also write immediately:

$$\text{var}\{\hat{Y}_h\}_{lr} = N^2_h\,\text{var}(\bar{y}_h)_{lr} \tag{4}$$

for an estimate of the variance of the regression total in stratum (h). An estimate of the variance for the overall total, say of plant capacity, becomes then:

$$\text{var}\,\{\sum_{h=1}^{L} N_h\,\hat{Y}_h\} = \text{var}\,\{\hat{Y}\}_{lr}$$

and

$$\text{var}\{\hat{Y}\}_{lr} = \sum_{h=1}^{L} N_h^2 \{s_{y.x}^{2h} + K_h (s_{yh}^2 - s_{y.x}^{2h})\}/n_{1h} \qquad (5)$$

where N_h is the population size in stratum (h).

Estimates based on both mail and telephone responses; that is, where the variable is measured in both cases may be written as:

$$\hat{Y}_T = \sum_{h=1}^{L} N_h \{n_{h1}\bar{y}_{h1} + (n_h - n_{h1})\bar{y}_{h2}\}/n_h = \sum_{h=1}^{L} N_h \bar{y}_h^* \qquad (6)$$

with $\bar{y}_{h1}$ the average of the mail responses and $\bar{y}_{h2}$ the average of the telephone responses. The sampling variance of $\hat{Y}$ above may be estimated as follows (after Cochran section 13.6):

$$\text{var}(\hat{Y}_T) = \sum_{h=1}^{L} N_h^2 \{s_h^2 + (f_h - 1) w_h s_{h2}^2\}/n_h = \sum_{h=1}^{L} N_h^2 s_h^{2*}/n_h \qquad (7)$$

where

$$f_h = \frac{n_h - n_{h1}}{n_{h2}}$$

$$w_h = \frac{n_h - n_{h1}}{n_h}$$

$$s_h^2 = \sum_{i=1}^{n_{h1}+n_{h2}} (y_{hi} - \bar{y}_h)^2 / (n_{h1} + n_{h2} - 1)$$

$$s_{h2}^2 = \sum_{i=1}^{n_{h2}} (y_{hi} - \bar{y}_{h2})^2 / (n_{h2} - 1)$$

VII. RECOMMENDATIONS

A. Sample Size

1. National Estimate

If only national estimates are required a sample size of 1300 plants from the three largest sources in numbers of plants (Petroleum Products and Storage, Grain Milling, and Grain Handling) and a complete canvas of the remainder is recommended.

2. State Estimates

If state by state estimates are required, a sample of one hundred plants from each state where that many or more plants are available is recommended.

B. Sampling Frames

More or less complete lists of plant locations are available for all the sources other than petroleum products and storage. If a suitable list of these storage locations cannot be obtained, a list of the locations of major company headquarters could be sampled in hopes of obtaining the required information indirectly.

C. Stratification

Where sampling is involved, the respective plant listings should be stratified by state and, where available, by some measure of plant capacity.

D. Sampling

To select the plant samples, the locations should be sorted first by states and then by capacity. The sampling interval is then determined by dividing the total number of plants in the national population (state, if a state sample is desired) by the desired sample size rounded to the nearest integer. A systematic sample with a random start is next selected with the sampling interval determined as above.

E. Recommended Follow-up Procedures

1) Certified mail follow-up after 15 days.
2) Regular mail follow-up 25 days after the initial mailing.
3) Telephone interviewing of a subsample of nonrespondents beginning 35 days after the initial mailing if the response rate at that time falls below 85 percent. This subsample should be large enough to yield a final response rate of 85 percent assuming all telephone interviews are obtained. The subsampling procedure should parallel that used in the initial survey, or if the initial mailing was a canvas, the nonrespondents should be ordered by state and a systematic random sample selected.

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Appendix I

Air Pollution Control Survey Forms
for
Specified Air Pollution Sources

Asphalt Batching Industry

Brick and Tile Industry

Coal Cleaning Industry

Grain Milling and Handling Industry

Lime Industry

Petroleum Refinery Industry

Petroleum Storage

Rubber (Tires) Industry

Secondary Nonferrous Metallurgy Industry

Sulfuric Acid Industry

Varnish Industry

AIR POLLUTION CONTROL SURVEY - Asphalt Batching Industry

Date

Section I. GENERAL INFORMATION *(complete the following items)*

1. Name and location of plant

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

2. Name and location of parent company *(if applicable)*

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

3. Average number of production and production-related workers at this plant for 1970 was _____. *Workers, up through the working foremen, engaged in fabricating, processing, assembling, inspecting, receiving (not delivering), storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other functions closely associated with these operations.*

4. Person to contact regarding this survey

   a. Name _____ b. Area code/phone _____

5. Your employer identification number provided by the U. S. Social Security Administration _____

AIR POLLUTION CONTROL SURVEY - Asphalt Batching Industry

Section II. PLANT INFORMATION *(complete the following items)*

1. Rated plant capacity

   a. Total hourly capacity for asphalt mix _____short tons

   b. Average number of days per year the plant operates _____

   c. Average number of hours per day the plant operates _____

2. List the sizes and numbers of mixers at the plant.

Size of Mixer (tons/batch)	Number of mixers this size	Size of Mixer (tons/batch)	Number of mixers this size

3. Secondary Sources of Dust. Are the exhausts from secondary sources of dust (e.g., elevators, screens, and bin discharges), manifolded to the same point as the dryer exhaust gases? ☐ Yes ☐ No

4. Type of fuel used. Coal ☐ Oil ☐ Gas ☐

AIR POLLUTION CONTROL SURVEY - Asphalt Batching Industry

Section III. PLANT PROCESS INFORMATION

1. Aggregate Dryers *(use one line for each dryer in plant)*

Dryer number	Rated capacity (tons/hr)	Year installed	Air pollution control system		
			Type system[1]	Year installed	Removal efficiency for particulates (%)

[1] Please use the following abbreviations:

Cyclone collector	CC	Electrostatic precipitator	ESP
Wet scrubber	WS	Multiple cyclone collector	MCC
Fabric filter	FF		

If the system has several pieces of connected equipment, indicate the sequence by, for example, MCC/ESP.

AIR POLLUTION CONTROL SURVEY - Brick and Tile Industry	Date

Section I. GENERAL INFORMATION *(complete the following items)*

1. Name and location of plant

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

2. Name and location of parent company *(if applicable)*

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

3. Average number of production and production-related workers at this plant for 1970 was _____. *Workers, up through the working foremen, engaged in fabricating, processing, assembling, inspecting, receiving (not delivering), storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other functions closely associated with these operations.*

4. Person to contact regarding this survey

   a. Name _____ b. Area code/phone _____

5. Your employer identification number provided by the U. S. Social Security Administration _____

AIR POLLUTION CONTROL SURVEY - Brick & Tile Industry

Section II. PLANT INFORMATION *(complete the following items)*

1. Rated plant capacity

   a. Bricks _____1000/day.

   b. Other _____100 bricks/day equivalent or _____ tons/day.

2. Fuel used to fire kilns

Fuel type	1970 Consumption	Average sulfur content	Average ash content
Gas	million cu. ft.	%	%
Oil	thousand gallons	%	%
Coal	tons	%	%

3. The average fluoride content of the clay used _____% by weight.

AIR POLLUTION CONTROL SURVEY - **Brick and Tile Industry**

Section III. PLANT PROCESS INFORMATION

I. Kilns *(use one line for each kiln in plant)*

Kiln number[1]	Kiln type[2]	Rated capacity[3]	Year installed	Operating time (days/yr)	Exhaust gas		Air pollution control system			
					Volume[4] (acfm)	Temp. (°F)	Type system[5]	Year system installed	Estimated removal efficiency (%)	
									particulates	fluorides

[1] For reference purposes only.

[2] Specify.

[3] Indicate as 1000 bricks/day or tons/day.

[4] Actual cubic feet per minute.

[5] Please use the following abbreviations:

Cyclone collector	CC	Electrostatic precipitator	ESP
Wet scrubber	WS	Multiple cyclone collector	MCC
Fabric Filter	FF		

If the system has several pieces of connected equipment, indicate the sequence by, for example, MCC/ESP.

AIR POLLUTION CONTROL SURVEY - Coal Cleaning Industry	Date

Section I. GENERAL INFORMATION *(complete the following items)*

1. Name and location of plant

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

2. Name and location of parent company *(if applicable)*

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

3. Average number of production and production-related workers at this plant for 1970 was _____. *Workers, up through the working foremen, engaged in fabricating, processing, assembling, inspecting, receiving (not delivering), storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other functions closely associated with these operations.*

4. Person to contact regarding this survey

   a. Name _____ b. Area code/phone _____

5. Your employer identification number provided by the U. S. Social Security Administration _____

AIR POLLUTION CONTROL SURVEY -- Coal Cleaning Plants

Section II. PLANT INFORMATION *(complete the following items)*

1. Rated plant capacity

   a. List daily capacity for each item:

   Pneumatic cleaning _____tons/day Wet method cleaning _____ tons/day

   Flash drying _____tons/day Fluidized-bed drying _____ tons/day

   Other[1/] _____tons/day

   b. Plant normally operates _____hrs/day and _____days/yr.

2. Plant process information (*use one line for each unit process*)

Unit process	Number	Year installed	Air pollution control system: Type system[2/]	Number used	Estimated removal efficiency for particulates (%)
Pneumatic cleaner					
Flash drier					
Fluidized-bed drier					
Other[1/]					

1/ Please specify.

2/ Please use the following abbreviations:

Fly ash and spark arrester	SA	Wet scrubber	WS
Afterburner	AB	Fabric filter	FF
Wet cap	WC	Electrostatic precipitator	ESP
Cyclone collector	CC	Multiple cyclone collector	MCC

If the system has pieces of connected equipment, indicate the sequence by, for example, MCC/ESP.

AIR POLLUTION CONTROL SURVEY - Grain Milling and Handling Industry	Date

Section I. GENERAL INFORMATION *(complete the following items)*

1. Name and location of plant

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

2. Name and location of parent company *(if applicable)*

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

3. Average number of production and production-related workers at this plant for 1970 was _____. *Workers, up through the working foremen, engaged in fabricating, processing, assembling, inspecting, receiving (not delivering), storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other functions closely associated with these operations.*

4. Person to contact regarding this survey

   a. Name _____ b. Area code/phone _____

5. Your employer identification number provided by the U. S. Social Security Administration _____

AIR POLLUTION CONTROL SURVEY - Grain Milling and Handling Industry

Section II. PLANT INFORMATION *(complete the following items)*

1. Actual plant production and rated capacity

Product	1970 throughput, 60-pound bushels						
	unloaded[1]	dried	cleaned	custom ground	commercial ground	shipped	stored
Hard wheat							
Soft wheat							
Corn							
Soybeans							
Milo							
Oats							
Rice							

2. Facility classified as (a)country ☐ or terminal ☐ ; wheat belt ☐ or feed grain ☐ elevator; and (b) custom ☐ or commercial ☐ feed mill.

3. If facility operates a terminal elevator, classify it as -- ☐ inland ☐ export ☐ river house.

4. Elevator capacity _____thousands of bushels.

5. Elevator operations

   a. harvest periods _____hours/day, _____days/week, _____days/year.
   b. nonharvest periods _____hours/day, _____days/week, _____days/year.

6. Estimated annual drier operations _____days/year.

7. Feedmill operations _____hours/day, _____days/week, _____days/year.

[1] Unloading includes weighing

AIR POLLUTION CONTROL SURVEY - Grain Milling and Handling Industry

Section III. PLANT PROCESS INFORMATION

I. Grain milling and handling processes

Process	Duct and air pollution control exhaust streams					
	Volume[1] (acfm)	Temp. (°F)	Control equipment: year installed	Control equipment: type[2]	Control equipment: efficiency	Exhaust emissions, (grains/std cu.ft.)
Truck unloading, include elevators						
Railcar unloading, include elevators						
Barge or ship unloading, include elevators						
Garner-bin and weigh-bin operations						
Drying						
Cleaning						
Storage bin venting						
Storage bin aeration						
Storage bin turning and transferring						
Trippers and spouting						
Railcar loading						
Barge and ship loading						
Building, cleaning, and vacuuming (housekeeping)						
Process grinding						

[1] Actual cubic feet per minute.

[2] Please use the following abbreviations:

Cyclone collector	CC	Electrostatic precipitator	ESP
Wet scrubber	WS	Multiple cyclone collector	MCC
Fabric Filter	FF		

If the system has several pieces of connected equipment, indicate the sequence by, for example, MCC/ESP. If a single system controls more than one process, please indicate also.

AIR POLLUTION CONTROL SURVEY - **Lime Industry**	Date

Section I. GENERAL INFORMATION *(complete the following items)*

1. Name and location of plant

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

2. Name and location of parent company *(if applicable)*

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

3. Average number of production and production-related workers at this plant for 1970 was _____. *Workers, up through the working foremen, engaged in fabricating, processing, assembling, inspecting, receiving (not delivering), storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other functions closely associated with these operations.*

4. Person to contact regarding this survey

   a. Name _____ b. Area code/phone _____

5. Your employer identification number provided by the U. S. Social Security Administration _____

AIR POLLUTION CONTROL SURVEY - Lime Industry

Section II. PLANT INFORMATION

1. Rated plant capacity

   a. Total daily capacity _____tons

   b. Average days per year the plant operates _____

2. Kilns *(use one line for each kiln in plant)*

Kiln number	Type[1]	Rated capacity (tons/day)	Year installed	Fuel			Air pollution control system		
				Type[2]	Ash content (percent)	Sulphur content (percent)	Type system[3]	Year system installed	Removal efficiency for particulates (%)

1 List rotary, vertical, or specify if other.

2 List if equipped for coal, oil, and for natural gas even though all fuels are not used.

3 Please use the following abbreviations:

Mechanical collector	MC	Fabric filter	FF
Wet scrubber	WS	Electrostatic precipitator	ESP

If the system has several pieces of connected equipment, indicate the sequence by, for example, MC/FF.

AIR POLLUTION CONTROL SURVEY - Petroleum Refinery Industry

Date

Section I. GENERAL INFORMATION *(complete the following items)*

1. Name and location of plant

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

2. Name and location of parent company *(if applicable)*

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

3. Average number of production and production-related workers at this plant for 1970 was _____. *Workers, up through the working foremen, engaged in fabricating, processing, assembling, inspecting, receiving (not delivering), storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other functions closely associated with these operations.*

4. Person to contact regarding this survey

   a. Name _____ b. Area code/phone _____

5. Your employer identification number provided by the U. S. Social Security Administration _____

AIR POLLUTION CONTROL SURVEY - Petroleum Refinery Industry

Section II. PLANT INFORMATION *(complete the following items)*

1. Plant production for 1970

   a. Crude oil throughput _____ barrels

   b. Average sulfur content of crude oil _____% by weight

2. Plant processes

Process	Average daily input (barrels)	Percentage of sulfur in the streams (% by weight)	Plant capacity (barrels/ stream day)
Catalytic cracking			
Reforming			
Distilling			
Hydrocracking			
Other *(specify)*			

3. Fuel consumed in plant processes

Fuel	Consumed in 1970	Sulfur content (% by weight)
Gaseous	cu. ft.	
Liquid	barrels	

4. Total amount of sulfur recovered in 1970 from process streams _____ tons

5. Capacity and year of installation of sulfur recovery plants:

   _____ capacity _____ year

   _____ capacity _____ year

   _____ capacity _____ year

AIR POLLUTION CONTROL SURVEY - Petroleum Refinery Industry

Section III. PLANT PROCESS INFORMATION

1. Gasoline storage tanks

FIXED ROOF STORAGE TANKS WITHOUT VAPOR RECOVERY			
Splash-fill			
Tank capacity (barrels)	Number of tanks this size	Average stock in these tanks (barrels)	Average annual throughput (barrels)
Submerged-fill			

CONSERVATION STORAGE TANKS WITHOUT VAPOR RECOVERY			
Tank capacity (barrels)	Number of tanks this size	Average stock in these tanks (barrels)	Average annual throughput (barrels)

2. Crude oil storage tanks

FIXED ROOF STORAGE TANKS WITHOUT VAPOR RECOVERY			
Splash-fill			
Tank capacity (barrels)	Number of tanks this size	Average stock in these tanks (barrels)	Average annual throughput (barrels)
Submerged-fill			

CONSERVATION STORAGE TANKS WITHOUT VAPOR RECOVERY			
Tank capacity (barrels)	Number of tanks this size	Average stock in these tanks (barrels)	Average annual throughput (barrels)

3. Tank vehicles *(use one line for each size vehicle without vapor recovery)*

Tank vehicle capacity (gallons)	Number of vehicles this capacity		Average 1970 throughput per vehicle (gallons/yr)
	With splash-fill	With submerged-fill	

4. Catalytic crackers

Type cracker [1]	Capacity (barrels/ stream day)	Year brought on stream	Catalyst recirculation rate (tons/hr)	Regenerator exit gas data							
				Volume (acfm)[2]	Temp. (°F)	Particulate control system			Gaseous control system		
						Type[3]	Efficiency (%)	Current emissions (lbs/hr)	Type[3]	Current emissions	
										SO_2 (lbs/hr)	CO (lbs/hr)

[1] FCC, HCC, or TCC.

[2] Actual cubic feet per minute.

[3] Please use the following abbreviations:

Afterburner	AB	Fabric filter	FF
Cyclone collector	CC	Electrostatic precipitator	ESP
Wet scrubber	WS	Multiple cyclone collector	MCC
CO Boiler	CO		

If the system has several pieces of connected equipment, indicate the sequence by, for example, CC/ESP.

5. Power boilers

a. Data on fuels used

Coal			Fuel oil		Natural gas
Annual quantity used latest year (1000 gals)	Average ash content (percent)	Average sulfur content (percent)	Annual quantity used latest year (1000 gals)	Average sulfur content (percent)	Annual quantity used latest year (1,000,000 cu.ft.)

b. Data on boilers and control systems

Boiler number	Year installed	Hours used per year	Capacity (1,000,000 Btu/hour of input)	Types of fuel[1]	Fly ash control system		
					Type[2]	Year installed	Average percent control achieved

[1] List if equipped for coal, oil, and/or natural gas even though all fuels are not used.

[2] Please use the following abbreviations:

Fly ash and spark arrester	SA	Wet scrubber	WS
Afterburner	AB	Fabric filter	FF
Wet cap	WC	Electrostatic precipitator	ESP
Cyclone collector	CC	Multiple cyclone collector	MCC

If the system has several pieces of connected equipment, indicate the sequence by, for example, MCC/ESP.

AIR POLLUTION CONTROL SURVEY - Petroleum Storage	Date

Section I. GENERAL INFORMATION *(complete the following items)*

1. Name and location of plant

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

2. Name and location of parent company *(if applicable)*

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

3. Average number of production and production-related workers at this plant for 1970 was _____. *Workers, up through the working foremen, engaged in fabricating, processing, assembling, inspecting, receiving (not delivering), storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other functions closely associated with these operations.*

4. Person to contact regarding this survey

   a. Name _____ b. Area code/phone _____

5. Your employer identification number provided by the U. S. Social Security Administration _____

AIR POLLUTION CONTROL SURVEY - Petroleum Storage Industry

Section II. PLANT INFORMATION *(complete the following items)*

1. Total storage capacity of tank farm in 1970 _____barrels
2. Amount of gasoline received in 1970 for storage _____barrels
3. Number of fixed roof storage tanks without vapor recovery, splash fill _____
4. Number of fixed roof storage tanks without vapor recovery, submerged fill _____
5. Number of fixed roof storage tanks with vapor recovery _____
6. Number of conservation storage tanks with vapor recovery _____
7. Number of conservation storage tanks without vapor recovery _____
8. Number of tank vehicles with vapor recovery _____
9. Number of tank vehicles without vapor recovery, splash fill _____
10. Number of tank vehicles without vapor recovery, submerged fill _____

AIR POLLUTION CONTROL SURVEY - Rubber (Tires) Industry	Date

Section I. GENERAL INFORMATION *(complete the following items)*

1. Name and location of plant

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

2. Name and location of parent company *(if applicable)*

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

3. Average number of production and production-related workers at this plant for 1970 was _____. *Workers, up through the working foremen, engaged in fabricating, processing, assembling, inspecting, receiving (not delivering), storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other functions closely associated with these operations.*

4. Person to contact regarding this survey

   a. Name _____ b. Area code/phone _____

5. Your employer identification number provided by the U. S. Social Security Administration _____

AIR POLLUTION CONTROL SURVEY - Rubber (Tire) Industry

Section II. PLANT INFORMATION

1. Rated plant capacity

   a. Total capacity of plant _____tires/yr

   b. Capacity estimate is based on _____hrs/day and _____days/yr

2. Banbury mixer *(use one line for each mixer in plant)*

Mixer number[1]	Rated capacity (lbs/hr input)	Year installed	Operating time (hrs/yr)	Exhaust gas		Air pollution control system			
				Volume[2] (acfm)	Temp. (°F)	Paired[3] mixers	Type system[4]	Year system installed	Estimated removal efficiency for particulates (%)

1 For reference purposes only.

2 Actual cubic feet per minute.

3 If more than one mixer's exhaust is combined, list the numbers of the combined mixers.

4 Please use the following abbreviations:

Cyclone collector	CC	Electrostatic precipitator	ESP
Fabric filter	FC	Multiple cyclone collector	MCC

If the system has several pieces of connected equipment, indicate the sequence by, for example, MCC/ESP.

3. Tire cord dipping *(use one line for each afterburner in plant)*

Afterburner					Year installed	Operating time (hrs/yr)	Inlet gases			Estimated removal efficiency for hydrocarbons (%)
Number[1]	Direct-type or catalytic	Type fuel used: Oil	Gas	Amount used (gals. or cu. ft/hr			Volume (acfm)[2]	Temp. (°F)	Btu content	

1 For reference purposes only.

2 Actual cubic feet per minute.

AIR POLLUTION CONTROL SURVEY - Secondary Nonferrous Metallurgical Industry

Date

Section I. GENERAL INFORMATION *(complete the following items)*

1. Name and location of plant

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

2. Name and location of parent company *(if applicable)*

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

3. Average number of production and production-related workers at this plant for 1970 was _____. *Workers, up through the working foremen, engaged in fabricating, processing, assembling, inspecting, receiving (not delivering), storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other functions closely associated with these operations.*

4. Person to contact regarding this survey

   a. Name _____ b. Area code/phone _____

5. Your employer identification number provided by the U. S. Social Security Administration _____

AIR POLLUTION CONTROL SURVEY - Secondary Nonferrous Metallurgical Industry

Section II. PLANT INFORMATION

1. Melting Operations (*use one line for each furnace in plant*)

Furnace number	Furnace type	Rated capacity (lbs/hr)	Type(s) of metal(s) melted	Year installed	Operating time (hrs/yr)	Exhaust gas		Air pollution control system			
						Volume[1] (acfm)	Temp. (^{o}F)	Paired[2] furnace	Type[3] system	Year system installed	Removal efficiency for particulates (%)

1 Actual cubic feet per minute.

2 Indicate furnace pairing by furnace numbers.

3 Please use the following abbreviations:

Fly ash and spark arrester	SA	Wet scrubber	WS
Afterburner	AB	Fabric filter	FF
Wet cap	WC	Electrostatic precipitator	ESP
Cyclone collector	CC	Multiple cyclone collector	MCC

If the system has several pieces of connected equipment, indicate the sequence by, for example, MCC/ESP.

AIR POLLUTION CONTROL SURVEY - Sulfuric Acid Industry	Date

Section I. GENERAL INFORMATION *(complete the following items)*

1. Name and location of plant

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

2. Name and location of parent company *(if applicable)*

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

3. Average number of production and production-related workers at this plant for 1970 was _____. *Workers, up through the working foremen, engaged in fabricating, processing, assembling, inspecting, receiving (not delivering), storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other functions closely associated with these operations.*

4. Person to contact regarding this survey

   a. Name _____ b. Area code/phone _____

5. Your employer identification number provided by the U. S. Social Security Administration _____

AIR POLLUTION CONTROL SURVEY - Sulfuric Acid Industry

Section II. PLANT INFORMATION *(complete the following items)*

1. Rated plant capacity as total daily capacity _____ short tons (100% H_2SO_4)

2. Number of trains in the plant _____

3. Would consumption of 10 - 20% more steam make the steam balance in the plant critical enough to require auxiliary heat? ☐ Yes ☐ No

AIR POLLUTION CONTROL SURVEY - Sulfuric Acid Industry

Section III. PLANT PROCESS INFORMATION ON TRAIN OPERATIONS

1. What year was each train installed? a.____ b.____ c.____

2. Train operations. Answer "yes" or "no" if units or choice of answers do not follow the questions.		Train #1	Train #2	Train #3
a. Does each train have excess blower capacity just prior to catalyist cleaning?				
b. What is the excess blower capacity? (inches of water)				
c. What is the percentage of SO_2 in the gas to the convertor?	minimum	%	%	%
	average	%	%	%
	maximum	%	%	%
d. What is the operating temperature in the last (3rd or 4th) convertor bed?	average	°F	°F	°F
	maximum	°F	°F	°F
e. If you have a 3-stage conversion, do you have				
--provisions for adding a 4th stage and the necessary heat exchangers?				
--space for adding a 4th separate stage and its exchanger?				
f. If you have only one absorber, do you have				
--provisions for adding a 2nd absorber?				
--space for adding a 2nd absorber and an auxiliary blower (if required)?				
g. What types of mist control devices are being used at present? (high velocity or high efficiency fiber, fiber pad, electrostatic precipitator, or specify)				
h. What is the estimated efficiency of each device?		%	%	%
i. If a mist control device is not being used at present, could the absorber stack support it if it is installed?				
j. What is the conversion efficiency for each train?				
k. What is the percentage of onstream time that each train operates--	at nominal capacity	%	%	%
	below capacity	%	%	%
	above capacity	%	%	%

AIR POLLUTION CONTROL SURVEY - Varnish Industry

Date

Section I. GENERAL INFORMATION *(complete the following items)*

1. Name and location of plant

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

2. Name and location of parent company *(if applicable)*

   a. Name _____

   b. Number and street _____

   c. City _____ d. County _____

   e. State _____ f. ZIP code _____

3. Average number of production and production-related workers at this plant for 1970 was _____. *Workers, up through the working foremen, engaged in fabricating, processing, assembling, inspecting, receiving (not delivering), storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other functions closely associated with these operations.*

4. Person to contact regarding this survey

   a. Name _____ b. Area code/phone _____

5. Your employer identification number provided by the U. S. Social Security Administration _____

AIR POLLUTION CONTROL SURVEY - Varnish Industry

Section II. PLANT INFORMATION

1. Total annual plant capacity _____gallons

Capacity estimate based on _____hrs/day and _____days/year

2. Varnish Cooking Tank Data *(complete the table below)*

Tank number[1]	Capacity (gals/ batch)	Batch cooking time (hours)	Tank enclosed[2]	Emission control				
				Afterburner				
				Direct-fire, catalytic or note	Type fuel used		Amount used (gals. or cu. ft/hr.	Estimated efficiency %
					Oil	Gas		

1 Tank number for reference only.

2 Enter "yes" or "no" in column to indicate whether or not tank is enclosed.